I. Introduction

The Department is seeking comment on draft soil remediation standards that it is developing in accordance with the Brownfield and Contaminated Site Remediation Act, N.J.S.A. N.J.S.A. 58:10B-1.1 et seq. The draft soil remediation standards and supporting documentation are available on the Department's web site at http://www.nj.gov/dep/srp/regs/srs/
Information on the web site includes:

1) An introduction that briefly discusses several rulemaking and policy issues, and a summary of exposure pathway specific issues;

2) A master table with draft soil remediation standards for all the exposure pathways being considered and proposed laboratory practical quantitation levels; and

3) Basis and background documents for the following exposure pathways:

- The ingestion and dermal exposure pathway;
- The inhalation exposure pathway; and
- The impact to ground water exposure pathway.

When adopted, the soil remediation standards will replace the Department's soil cleanup criteria (SCC) guidance. These rules will work in concert with the Technical Requirements for Site Remediation, N.J.A.C. 7:26E. Therefore, the Department intends to amend the Technical Rules accordingly.

1. Risk based standards

The Department is proposing soil remediation standards for the combined ingestion and dermal exposure pathway and the inhalation exposure pathway based on residential and nonresidential exposure scenarios. The Department is proposing to apply residential standards to children's day care and school exposure scenarios.

The standards developed for the impact to ground water exposure pathway are based on the protection of Class IIA aquifer standards. Impact to ground water standards for Class I and Class III aquifers will continue to be developed on a site-by-site basis.

In accordance with the Brownfield and Contaminated Site Remediation Act, N.J.S.A. 58:10B-12, the draft soil remediation standards are developed for the protection of human health and therefore, are not specifically developed to be protective of ecological resources. Maximum contaminant levels or "cap" values are not proposed at this time for specific contaminants or groups of contaminants. However, high levels of contamination must be evaluated, on a site by site basis, for potential ecological impacts as well as, for the presence of free and residual product pursuant to the Technical Requirements for Site Remediation, N.J.A.C. 7:26E.

2. Selection of contaminants

The Department is proposing to develop soil remediation criteria for 140 contaminants. To generate the list of contaminants for the development of soil remediation standards, the Department reviewed and compared several existing contaminant or constituent lists. The following lists of contaminants were included in this review:

USEPA Contract Laboratory Program (CLP) Target Analyte List/Target Compound List
USEPA Priority Pollutant List
NJ Existing Soil Cleanup Criteria
USEPA Soil Screening Levels
NJ Ground Water Quality Standards

From these lists, a combined, inclusive list of 163 compounds was generated. From the combined list, the Department elected to remove 26 contaminants for a number of reasons. Fourteen contaminants were deleted because there was no readily available toxicity information. The Department deleted six separate contaminants that were listed as separate isomers on the source lists. In addition, five common elements were deleted because they are analyzed to correct for any interferences they may cause in the analytical method of other contaminants. Asbestos was removed due to analytical concerns.

Trivalent chromium and hexavalent chromium are not addressed in this interested party review. The Department has formed a chromium workgroup to review issues related to chromium contamination. Once these issues have been resolved, the Department will develop chromium soil remediation standards.

It should be noted that the Department can develop interim soil remediation standards for other contaminants on a case specific basis.

3. Interim specific standards

The Department is proposing to include rule provisions that will allow for the development of interim specific criteria in two circumstances. First, the Department will be able to develop an interim specific standard for any contaminant that does not have a standard as needed. Second, an interim specific standard may be developed when current scientific information indicates that an existing standard is no longer appropriate. For example, a standard may no longer be appropriate when toxicity data for a chemical are changed or when a groundwater remediation standard changes.

In both situations, interim specific standards would be developed using the procedures adopted in the Soil Remediation Standards rules. Interim specific standards may also be affected by practical quantitation levels or background values. The Department will post all interim specific standards on the Department's web site and interim specific standards will be adopted as promulgated standards by rule as soon as reasonably possible.

4. Toxicity hierarchy

The Department developed a hierarchy of sources for contaminant toxicity data that has been generally applied in the development of the soil remediation standards. Any deviations from this hierarchy are specifically discussed in the pertinent basis and background document. The toxicity data source hierarchy is as follows:

1. Toxicity data derived pursuant to the A280 amendments of the New Jersey Safe Drinking Water Act
2. Toxicity data from the USEPA Integrated Risk Information System (IRIS)
3. Other specified toxicity data sources

A280 toxicity data are first in the Department's hierarchy because this data source was developed by the Department in response to Legislative mandate in the 1984 amendments to the New Jersey Safe Drinking Water Act N.J.S.A. 58:12S-1 et seq. which is commonly referred to

by the bill number, A280. The Department has used these values to develop drinking water, ground water and surface water standards. The Department has made the policy decision, for consistency, to use the A280 toxicity data in the development of soil remediation standards. This will help provide consistency with regard to the Department's standards for different environmental media.

IRIS (Integrated Risk Information System) is the USEPA's toxicity database. It is appropriate that the IRIS database be used next in the toxicity source database because the Brownfield and Contaminated Site Remediation Act N.J.S.A. 58:10B-1 et set. has directed the Department to follow USEPA methods and procedures to the greatest extent possible. IRIS is used by USEPA in the development of soil screening levels (SSLs) and is used by environmental agencies across the country.

Other specified toxicity data sources include, but are not limited to, the California Environmental Protection Agency, the USEPA National Center for Environmental Assessment (NCEA), and the USEPA's Health Effects Assessment Summary Tables (HEAST, last revised in 1997). These sources are used when data are not available from either A280 or IRIS.

The impact to ground water soil standards are back calculated from the Ground Water Quality Standards. The Ground Water Quality Standards are also developed using this basic toxicity data source hierarchy.

5. Class C contaminants

The Department is proposing a new approach for the development of soil remediation standards for chemicals classified as Group C carcinogens (possible human carcinogens). These chemicals have some evidence of human carcinogenicity, but the evidence is not sufficient to warrant classification as Group B carcinogens (probable human carcinogens).

The Department is proposing an approach for Group C contaminants based on the following policy:

> Apply a risk management factor of 1×10^{-6} if a cancer slope factor is available and is judged by internal DEP review to be technically sound and based on adequate

toxicological data. If no suitable cancer slope factor is available, the soil remediation standard will be based on noncarcinogenic effects using the Reference Dose with a hazard quotient of 1 with an additional uncertainty factor of 10 to protect for possible carcinogenicity.

Formerly, the Department utilized the same approach employed by the USEPA Office of Drinking Water. This approach involved using the Reference Dose for noncarcinogenic effects with a hazard quotient of 1 with an additional uncertainty factor of 10 to protect for possible carcinogenic effects. If the data to develop a Reference Dose did not exist, the standard was based on the carcinogenic slope factor using a risk management factor of 1×10^{-5}. In contrast, the USEPA Superfund program continues to base its risk assessments for Group C contaminants on the carcinogenic slope factor, if available, with a risk management factor of 1×10^{-6}. If no carcinogenic slope factor is available, the Reference Dose for noncarcinogenic effects is used with a hazard quotient of 1 but without the incorporation of an additional uncertainty factor of 10.

The Department has developed an approach to be used throughout its implementing programs for Group C contaminants which is technically defensible as well as compatible with the various USEPA programs for the development of health-based standards and criteria. The use of an additional uncertainty factor of 10 when using the Reference Dose to provide sufficient health protection from possible carcinogenic effects is consistent with USEPA's water programs, and New Jersey's current standards and guidance for drinking water, surface water, ground water, and soil cleanups.

6. Practical quantitation levels

Conventional laboratory methods and a random sample of actual method detection limit (MDL) values on file with the Department's Office of Quality Assurance were used as a basis to develop compound specific practical quantitation level (PQL) values. Each value was also given scrutiny with respect to being "reasonable" and "routinely attainable by the laboratories" based on professional judgement and historical observations. The following procedures were performed to establish specific PQLs for each category of compounds.

Volatile Organic Compounds: PQLs were determined by taking the average of 10 times the average actual MDL value and 10 times the USEPA SW-846 method 8260B theoretical MDL value.

Semi-volatile Organic Compounds: PQLs were determined by taking the average of 10 times the average actual MDL value and the USEPA SW-846 method 8270C theoretical estimated quantitation limit (EQL) value. For any compounds for which an EQL did not exist, the average of 10 times the actual MDL value was used.

Pesticide Compounds: PQLs were determined by taking the average of 10 times the actual MDL value.

Metals: PQLs were obtained from the Contract Required Quantitation Limits from the USEPA Contract Laboratory Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration, ILM05.2.

7. Natural background

The Department will not require the remediation of a discharge to levels that are lower than natural background for any particular contaminant consistent with Legislative direction, N.J.S.A. 58:10B-12(g)(4). In the development of soil remediation standards, consideration of background concentrations of elements in soil is needed when the health-based criterion is lower than background concentrations. After an evaluation of a statewide survey of background soil concentrations, the Department has determined that arsenic is the only contaminant for which health-based criterion for direct contact (ingestion-inhalation) is lower than background concentrations. Therefore, the Department has developed a soil remediation standard for arsenic based on background concentrations specific to New Jersey.

The Department has selected a statewide standard for arsenic because the health-based criterion (0.5 mg/kg) is lower than naturally occurring concentrations.

The background concentration for arsenic for the soil remediation standard was selected as follows:

- The Division of Science, Research and Technology conducted a three year study to determine background values of selected metals (Sanders, 2003). This report is available on the Department's web site www.state.nj.us/dep/dsr/research/ under the soil heading. A total of 248 samples were collected in areas of the state that were not directly impacted by local discharges. The geographic provinces included the piedmont, ridge and valley, highlands, and the coastal plain. Samples were collected in either urban or rural areas within the sampled regions.

- The background samples were ranked by concentration, by distribution of the samples throughout the state including geographical region and population density (urban or nonurban). The distribution of the data was evaluated based on these factors.

	Arsenic concentration (mg/kg)
Location	95th percentile
Piedmont - urban	29
Ridge and Valley - rural	8
Highlands – rural	10
Coastal Plain – urban	15
Coastal Plain – rural	9

After an exhaustive evaluation of the data, the Department decided to select one statewide number for arsenic. The Department selected the lowest 95th percentile concentration of all the geographical and urban and nonurban categories to be representative of background for the state. This concentration is 8 mg/kg, the 95th percentile value for the Ridge and Valley region of the state. The Department selected 8 mg/kg as a reasonable background value that represents New Jersey soil that has not been impacted by anthropogenic input. Eight milligram per kilogram of arsenic also represents the 77th percentile of the combined statewide background data.

Use of a single state-wide value has the advantage of being easier to apply to remediations located in different regions of the state, and will not be affected by local population density.

The Department is aware of the wide variation in background concentrations in soil across the state. For this reason the determination of site specific alternative remediation standards based on background is acceptable. Currently, procedures to determine background on a site specific basis are outlined in the Technical Requirements for Site Remediation, N.J.A.C. 7:26E-3.10.

8. Reporting of numeric standards

The numeric soil remediation standards are expressed as mg/kg. The standards have been rounded to 2 significant figures for standards with a value greater than or equal to 10 mg/kg and to 1 significant figure for standards with a value less than 10 mg/kg, including those with a value less than 1. This approach is used by the USEPA Office of Solid Waste and Emergency Response and is described in Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24 (USEPA, 2001).

Standards were rounded as follows:

- If the first number beyond the last significant digit is less than 5, the last significant number remains the same; and the remaining numbers are dropped. For example, 4.438 is rounded to one significant figure, 4 and 44.38 is rounded to 2 significant figures, 44.

- If the first number beyond the last significant digit is more than 5, the last significant number increases by one and the remaining numbers are dropped. For example, 4.638 is rounded to one significant figure, 5 and 46.68 is rounded to 2 significant figures, 47.

- If the first number beyond the last significant digit is exactly 5, then the last digit is rounded to the closest even number. For example, 4.5 is rounded to one significant figure, 4 and 45.5 is rounded to two significant figures, 46.

The source of these rounding rules is contained in Hurlbert (1994).

9. Alternative remediation standards

The procedures to develop alternative remediation standards (ARSs) are based on site specific conditions and are contained in each exposure or transport pathway basis and background

document. Alternative remediation standards may be developed so that they are appropriate for nonresidential or residential uses **Alternative remediation standards are specific to the site and the pathway for which they are developed.** After an alternative remediation standard is developed for a given pathway it must be compared to the standards for the remaining exposure pathways. **The lower of the standards or ARS becomes the remediation standard at the site.**

10. Application of the remediation standards

There are a number of factors that will determine how the soil remediation standards will be applied for a contaminant at a site. Methods to determine application of a soil remediation standard are related to the phase of remediation. These methods are discussed below

A. Site Investigation (SI)

(1). Site use and general site information

- Residential or nonresidential: Determine based on current/potential use of the site (if possible at this stage).
- Ground water classification: Determine based on site location (if possible at this stage).
- Site size: Determine if the site is less than 2 acres, or greater than or equal to 2 acres (pertains to inhalation exposure pathway only).

(2). For each Area of Concern (AOC)/Site

Sample for suspected contaminants at potential areas of concern pursuant to the Technical Requirements for Site Remediation, N.J.A.C. 7:26E-3.

(3). Compare SI results with the soil remediation standards and PQLs (see Table 1, Master Table of the Pre-proposal Package).

Compare the suspected contaminant concentration detected in each sample to the soil remediation standard for each exposure pathway and the analytical PQL:

- Ingestion-dermal exposure pathway (res/nonres)
- Inhalation exposure pathway (res/nonres)
- Impact to ground water (IGW) exposure pathway (for Class II ground water)[1]

If the health based standard for a given contaminant for a given exposure pathway is lower than the analytical PQL for that contaminant, the PQL is used as the applicable standard for that exposure pathway. If the SI sample results of all suspected contaminants are **lower** than the soil remediation standards (or PQL if applicable) for all exposure pathways, an NFA may be issued for the AOC/Site.

(4) For each contaminant detected above the soil remediation standard (or PQL if the PQL is higher than the health-based standard)

(a) Ingestion-Dermal and Inhalation Exposure Pathways

If the SI sample results contain levels of a contaminant(s) **higher** than the lowest soil remediation standards (or PQL if applicable) for the ingestion-dermal and the inhalation exposure pathways, then a remedial investigation (RI) must be conducted for each AOC/Site.

(b) Impact to Ground Water Exposure Pathway

If the SI sample results are **higher** than the impact to ground water exposure pathway soil remediation standard (or PQL if applicable), it may be advisable to generate a site specific Alternative Remediation Standard (ARS) using one of the ARS options provided in the impact to ground water Basis and Background document. If an ARS is developed during the SI, the SI sample results are compared to the ARS. However, certain ARS options require completion of a ground water investigation (options E and F).

If the SI sample results are **lower** than the Impact to Ground Water ARS, then no further action is required for the Impact to Ground Water exposure pathway.

If the SI sample results are **higher** than the Impact to Ground Water ARS then a remedial investigation must be conducted for each AOC/Site.

B. Remedial Investigation (RI)

(1) Site use and information

- Residential or nonresidential: Determine based on current/potential use of the site (if possible at this stage).

- Ground water classification: Determine based on site location (if possible at this stage).
- Site size: Determine if the site less than 2 acres, or greater than, or equal to 2 acres (pertains to inhalation exposure pathway only).

(2) For each Area of Concern (AOC)/Site:

Delineate contaminants identified during the SI to the lowest applicable soil remediation standard (or PQL if applicable) or approved ARS for each compound, pursuant to the Technical Requirements for Site Remediation, N.J.A.C. 7:26E-4.

(3) Compare the RI results with the soil remediation standards and PQLs

(a) Ingestion-dermal exposure pathway

Conduct a point by point comparison[2] of the RI samples to the lowest applicable (residential/nonresidential) soil remediation standard (or PQL if applicable) or approved ARS for each contaminant.

Remedial options include treatment, removal, or control via institutional and/or engineering controls.

(b) Impact to Ground Water exposure pathway

Conduct a point by point comparison of the RI samples to the impact to Ground Water soil remediation standard (for Class II ground water) [3] (or PQL if applicable) or the ARS approved for the AOC/Site.

Remedial options include treatment or removal of soil. Engineering controls are generally not acceptable. Containment with engineering controls may be approved as part of a ground water/soil remedy when removal or treatment is deemed to be technically impractical.

(c) Inhalation exposure pathway

Conduct compliance averaging of RI data in accordance with the inhalation Basis and Background document and evaluate site contamination in 2 foot depth intervals. Compare the resulting contaminant concentration "average" to the appropriate inhalation soil remediation

standard (or PQL if applicable) or approved ARS based on site use and site size (residential, nonres <2 acres, nonres ≥2 acres).

If the contaminant concentration "average" is **higher** than the standards (or PQL if applicable) or approved ARS, remedial options include treatment, removal, or control via institutional and/or engineering controls.

Note: Even if the contaminant concentration "average" is **lower** then the inhalation soil remediation standards (or PQL if applicable) or approved ARS, individual samples may not exceed the (or PQL if applicable) or ARS soil remediation standards for the ingestion-dermal or the impact to ground water exposure pathways.

C. Post Remedial Action

(1) Site use and information

- Residential or nonresidential: Determine based on current/potential use of the site.
- Ground water classification: Determine based on site location.
- Site size: Determine if the site less than 2 acres, or greater than, or equal to 2 acres (pertains to inhalation exposure pathway only).

(2) For each AOC/Site

Sample to document completion of treatment or removal remedial action pursuant to the Technical Requirements for Site Remediation, N.J.A.C. 7:26E-6.

(3) Compare post RA results with the applicable soil remediation standards (or PQLs if applicable)

(a) For the ingestion-dermal and the impact to ground water exposure pathways

Conduct a point by point comparison of each post remedial action sample to the applicable soil remediation standards (or PQL if applicable) or approved ARS.

If the point-by-point post remediation sample results contain levels of a contaminant(s) **lower** than the soil remediation standards (or PQL if applicable) or approved ARS for the ingestion-

dermal and the impact to ground water exposure pathways, an NFA may be issued for the AOC/Site.

(b) For the inhalation exposure pathway

Compare the contaminant concentration "average" to the appropriate inhalation soil remediation standard (or PQL if applicable) or an approved ARS.

If the "average" of the post remediation sample results contains levels of a contaminant(s) **lower** than the applicable inhalation soil remediation standard (or PQL if applicable) or approved ARS, an NFA may be issued for the AOC/Site.

Note: Even if the contaminant concentration "average" is **lower** then the inhalation soil remediation standards (or PQL if applicable) or approved ARS, individual samples may not exceed the (or PQL if applicable) or ARS soil remediation standards for the ingestion-dermal or the impact to ground water exposure pathways.

11. Determining the need for institutional and engineering controls

The Brownfield and Site Remediation Act allows for the use of institutional and engineering controls as part of a remediation. A deed notice is an institutional control that must be used as part of a remediation whenever soil contamination will remain above a concentration that would allow for the unrestricted use of a property. Soil contamination remaining above the applicable standard for ingestion-dermal and inhalation exposure pathways will require an institutional control (deed notice) and may require engineering controls. See the compliance sections of the ingestion-dermal and inhalation exposure pathway basis and background documents for more information on the determination of applicable standards.

12. Consistency with the Pinelands Commission

Remediation at sites located within the jurisdiction of the Pinelands Commission as defined pursuant to N.J.S.A. 13:18A et seq. shall be conducted consistent with the Pinelands Comprehensive Management Plan, N.J.A.C. 7:50, including any Memorandum of Agreement entered into between the Department and the Pinelands Commission.

13. Compliance

Determining compliance is related to the physical characteristics and risk assessment assumptions associated with each exposure or transport pathway. Therefore, sampling requirements to determine compliance with the soil remediation standards varies for each exposure pathway. Sampling requirements and compliance options are discussed within each exposure pathway basis and background document.

II. Exposure Pathway Highlights

1. Combined Ingestion and Dermal Absorption Exposure Pathway

A. The exposure pathway used to develop the current Soil Cleanup Criteria is replaced with a combined ingestion-dermal absorption exposure pathway. (See Section I of the Ingestion –Dermal Basis and Background document.)

- This approach is consistent with USEPA and acknowledges that exposure occurs concurrently via the dermal and ingestion pathways
- Each combined exposure pathway equation employs the same target risk as the other exposure pathways and is based upon an incremental lifetime cancer risk of 10^{-6} or a hazard quotient of 1.
- Of ~~145~~ 140? chemicals, approximately half include a dermal component; the remaining standards are based on ingestion alone. As a result, those chemicals that have a dermal component will have lower standards than our current Soil Cleanup Criteria levels. (See Sections II & III of the Ingestion –Dermal Basis and Background document.)

B. The nonresidential exposure scenario is changed (See Section II of the Ingestion–Dermal Basis and Background document)**.**

- The Department is proposing to use USEPA's outdoor worker exposure scenario as the basis for the nonresidential standards, rather than the indoor worker exposure scenario used in the current Soil Cleanup Criteria. **This scenario is less conservative than the nonresidential exposure scenario used in the current Soil Cleanup Criteria.**

C. All toxicity information is updated. (See Table A-4 of the Ingestion–Dermal Basis and Background document.**)**

- Toxicity information has been incorporated according to an established hierarchy. (See Section IV of the Ingestion –Dermal Basis and Background document.) **As a result, chemicals with new toxicity data will have different standards than the current Soil Cleanup Criteria levels.**

D. Alternative Remediation Standards are limited for this exposure pathway (See Section VI of the Ingestion –Dermal Basis and Background document.**)**

- An alternative remediation standard may be based on 1) advancements in methodology that support standards derivation such as new toxicity or exposure information, improved or advanced models and methods, (2) appropriate site-specific default parameters, or (3) different land use determinations such as a recreational use scenario.

E. Compliance with the ingestion–dermal standards (See Section VII of the Ingestion – Dermal Basis and Background document.**)**

- All sampled contaminants that exceed their relevant ingestion-dermal absorption standard must be remediated
- Site wide averaging is **not** routinely accepted, except on a case-by-case basis when sampling is deemed to be representative of the contaminant concentrations across the site
- Compliance averaging over an area of concern is allowed
- Averaging of sporadic low levels of contaminants with no discernable source area and minimal exceedances of a standard during post excavation sampling is allowed.

2. Inhalation Exposure Pathway

A. General Comment on the Use of Inhalation Exposure Pathway Related Soil Remediation Standards

- Under the current soil cleanup criteria (NJDEP, 1999), inhalation exposure is the critical pathway for the derivation of criteria for only 7 compounds. These are carbon tetrachloride, chloroform, 1,3-dichloropropene, 1,1,2,2 tetrachloroethane, tetrachloroethene, toxaphene, and trichloroethene. Under the proposed soil remediation standards, the relevance of the inhalation pathway was evaluated for all 145 compounds. This differs from the May 1999 soil cleanup criteria where only 48 contaminants were evaluated. Preliminary evaluation

indicates the inhalation pathway will be initially critical in the investigation of acenapthylene, acetophenone, benzo(g,h,i)perylene, , copper, hexachlorocyclopentadiene, 2-nitroaniline, and phenanthrene. Realistically, additional compounds will likely be regulated via the inhalation pathway after alternative remediation standard analysis is accomplished for the respective impact to ground water criteria. Consequently, the investigative approach of many contaminated sites previously unconcerned with impacts from airborne contaminants will now have to be modified.

B. Compliance Averaging (See Section VII of the Inhalation Basis and Background document.)

- The proposed compliance methods for the inhalation exposure pathway involve averaging of soil sample results from vertically and horizontally defined layers of contaminated soil. Currently, compliance for the 7 compounds regulated using inhalation exposure pathway based Soil Cleanup Criteria employs a point by point compliance mechanism. In other words, no exceedance of the criterion is presently allowed. The proposed use of averaging is justifiable due to the nature of the exposure pathway because a person does not breath contaminants generated from a single location but inhales an integrated dose from a larger area inclusive of a number of locations. However, averaging is not currently acceptable pursuant to the Technical Requirements for Site Remediation, N.J.A.C. 7:26E. Compliance averaging is less conservative than a point by point compliance protocol. If adopted, the averaging procedures will require amendment of the Technical Requirements for Site Remediation, N.J.A.C. 7:26E.

C. Use of a 95% Upper Confidence Limit of a Mean Value (See Section VII of the Inhalation Basis and Background document)

- Consistent with relevant USEPA guidance, the 95% upper confidence limit of the mean is used to determine compliance with the standard. The 95% upper confidence limit of the mean is a conservative estimate of the mean that is meant to compensate for the limited data typically available to determine compliance. While this procedure is statistically valid, its use will add a layer of complexity to the site evaluation. Efforts are currently underway to attempt to simplify the process of determining the 95% upper confidence limit of the mean through the use of an Excel spreadsheet or other software.

D. Use of Fixed Layers in Evaluating Compliance (See Section VII of the Inhalation Basis and Background document)

- Part of the compliance protocol involves the evaluation of zones or layers of predetermined size. For residential type-sites, the size of this layer is 0.25 acres in area with a depth of 2 feet. For nonresidential type sites, the size of this layer is 2 acres in area with a depth of 2 feet. The depth of the contamination determines the number of layers required to be evaluated. The use of layers of fixed size is done in part to preclude hot spots from being "diluted" by lower sample concentration results situated throughout the soil column.

E. Selection of a Default Residential Site Size (See Appendix G of the Inhalation Basis and Background document.)

The default residential lot size used in this document is 0.25 acres. This represents an adjustment of an USEPA assumption. The USEPA assumes a residential lot size of 0.5 acres. The adjustment to 0.25 acres was made to reflect the fact that New Jersey is the most densely populated state in the nation.

F. Pro Rata Application of the 95% Upper Confidence Level of the Mean (See Section VII of the Inhalation Basis and Background document)

- The compliance methodology calls for a weighting of clean areas (equal or less than the standard) versus contaminated areas (exceed the standard) within a given layer under evaluation. These clean and contaminated zones reflect the data collected, but are not directly proportional to the number of samples collected. Because sampling is typically biased towards the source of the contamination, a frequent situation is that there are a disproportionate number of "contaminated" samples (versus "clean" samples) in comparison to the proportion of the site that is actually contaminated. Evaluating the data without compensating for the areas that are actually clean or contaminated results in a conservative skewing of the findings. The proposed compliance methodology is an attempt to more accurately reflect the source area with respect to contaminant levels. That is why the weighting component was incorporated into the compliance process.

- Software is available to accomplish the task of dividing the layers into clean and contaminated zones and computing the size of the respective areas. However, the expectation is that the Department will actually employ this software only when necessary to confirm output produced by a responsible party or a contracted consultant on a spot check basis. The Department's GIS system also has the capability of producing the necessary information as well.

G. Truck Traffic Assumptions (See Section IV C and D in the Inhalation Basis and Background document)

- Typically the residential and nonresidential exposure scenarios are primarily distinguished by the length and frequency the receptors are present; however, receptor activity and receptor age are also aspects that are considered. Similarly, if one considers what occurs at a given type of site, onsite activity can be another distinguishing characteristic. Nonresidential activities are generally synonymous with industrial or commercial operations, and a major aspect of such operations is vehicle activity to move goods or personnel using large vehicles. This truck traffic can cause a significant increase in the amount of dust or particulates in the air and needs to be evaluated for its potential health implications. Truck traffic is not considered for residential land use mainly because of the smaller lot sizes involved for most residential properties and because smaller vehicles like cars are almost always present in comparison to 18 wheel trucks. Also the frequency of the traffic is expected to be much lower at a residential location compared to a nonresidential location.

H. Default Vehicle Activity Assumption (See Section IV D in the Inhalation Basis and Background document.)

- The assumed vehicle activity is 25 trucks per day per 2 acres of a nonresidential site. This value originated from the scientific literature. Analysis of New Jersey Department of Transportation data also supports the general magnitude of such a default value. It should be noted that the compliance methodology employs a fixed area approach for nonresidential sites. Each site is to be evaluated in 2 acre blocks with 25 trucks per day the assumed activity level on each 2 acre block.

I. Site Size Exclusion for Particulate Based Soil Remediation Standards (See Section IV C in the Inhalation Basis and Background document)

- Nonresidential sites smaller than 2 acres were excluded from the application of particulate based standards where vehicle activity was a component. This is because these sites would be too small to support the assumed vehicle activity. Therefore, these small nonresidential sites would be evaluated in part using soil remediation standards based only on wind generated particulate contamination. The 2-acre site size was initially chosen because it was the default assumption used to generate the proposed nonresidential soil remediation standards. This default was in turn derived from an evaluation of size information for sites subject to remediation (Appendix G of the Inhalation Basis and Background document). The significance of limiting the application of particulate based standards to sites 2 acres or larger is that at least half of the contaminated nonresidential sites encountered in the future would be expected to be less than 2 acres in size.

J. Apparent Contradiction for Particulate Based Nonresidential Soil Remediation Standards

- Particulate based nonresidential soil remediation standards for sites of 2 acres or more will be lower (more conservative) than similar residential exposure scenarios related standards. This is because in the nonresidential exposure scenario, airborne contaminants generated by vehicle traffic far exceeds those generated by the wind alone. This means that the unrestricted standard would be associated with the soil remediation standard associated with the nonresidential exposure scenario and not the residential exposure scenario. This will initially be the case for 41 compounds.

K. The Regulation of Compounds at Their Chemical Saturation Level (See Section III C of the Inhalation Basis and Background document.)

- The soil saturation level or Csat corresponds to the contaminant concentration in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and saturation of soil pore air have been reached. Above this concentration, the soil contaminant may be present in free phase, i.e., nonaqueous phase liquids (NAPLs) for contaminants that are liquid at ambient soil temperatures and pure solid phases for compounds that are solid at ambient soil temperatures. The USEPA regulates chemicals that

exist as liquids under ambient conditions at the Csat level. The inhalation pathway committee decided not to include numeric standards for compounds that exceeded their Csat values because Csat represents free product. Free product is more appropriately addressed under the application of the Technical Requirements for Site Remediation (N.J.A.C. 7:26E), the enforcement of the Ground Water Quality Standards (N.J.A.C. 7:9-6), and under the standards developed by the impact to ground water exposure pathway. Furthermore, the regulatory authority for developing the soil remediation standards specified that the basis for the standards should be health based. Consequently, regulation on the basis of free product from the perspective of the inhalation exposure pathway is inappropriate.

3. Impact to Ground Water Exposure Pathway

A. Purpose

- The impact to ground water soil remediation standards are designed to prevent the unacceptable risk to human health from the ingestion of contaminated ground water caused by the migration of chemicals from the unsaturated soil zone to the ground water. It is not appropriate to use the impact to ground water standards to determine when a ground water sample should be collected. The Technical Requirements for Site Remediation will be amended to be consistent with this approach.

B. Lower Impact to Ground Water Standards

- The impact to ground water standards will be protective of Class II-A ground waters at sites where site specific information is not available. To ensure an adequate margin of safety in the absence of site specific information, the resulting impact to ground water standards are conservative. As a result, more sites will need to conduct site investigations for this pathway.

C. Updated Models and Methodologies

In February of 1992 the Department proposed Subsurface Soil Cleanup Standards for the Soil-to-Ground Water Pathway. These standards were never adopted but have been used by the Department as Soil Cleanup Criteria. For this current effort, the Department has decided to use USEPA's simple partitioning equation that is presented in the May 1996 USEPA "Soil Screening Guidance: Technical Background Document" (USEPA, 1996) and other USEPA methodologies, in accordance with N.J.S.A.58:10B-12. As a result, the impact to groundwater standards

proposed here are, in many instances, more conservative than the 1992 Soil Cleanup Criteria. The major differences between the 1992 and the current standards development effort are noted below.

(1) Volatile Organic Compounds

The following assumptions were used in deriving the 1992 proposed Subsurface Soil Standards for the Soil-to-Ground Water Pathway for volatile organic compounds:

- The concentration of contaminants in ground water was averaged over a 70 year time. This assumption resulted in the ground water quality standards being exceeded for some period of time at the beginning of the 70 year period.

- A 6 foot clean soil zone between the contaminated soil and ground water assumed.

- All subsurface soil standards that were calculated to be lower than 1 mg/kg were, based on policy, increased to 1 mg/kg.

The current impact to ground water soil remediation standards make the following related assumptions.

- A 70 year time-averaged ground water standard is not used. Instead the simple partitioning model generates standards that are protective of ground water quality immediately in all cases.

- The proposed impact to ground water soil remediation standards assume that soil contamination is present at the water table.

- The proposed to ground water soil remediation standards are calculated and subjected to a generally accepted method of rounding or may be modified based on PQLs.

(2) Semi-Volatile Organic Compounds, Pesticides and PCBs

The 1992 proposed Subsurface Soil Cleanup Criteria for the Soil-to-Ground Water Pathway for semi-volatile organic compounds were derived using an arbitrary ranking system based on solubility, biodegradation and toxicity. A ranking sum was used to determine an arbitrary soil standard. It is now believed that this system may not be protective of ground water. The ranking system is not scientifically valid, and no new semi-volatile criteria have since been developed using this system. The ranking system is unique to New Jersey, and has no USEPA, other regulatory agency, or scientists' backing. When calculating new semi-volatile criteria, the Department now uses USEPA's simple partitioning model or Synthetic Precipitation Leaching Procedure test results. Furthermore, the ranking system is used only for semivolatiles and therefore there is no consistency in the methodologies used for other classes of contaminants.

(3) Inorganic Chemicals

The 1992 proposed Subsurface Soil Cleanup Criteria for the Soil-to-Ground Water Pathway did not include standards for inorganic chemicals. Consistent with USEPA, the proposed soil standards include remediation standards for inorganic chemicals that are protective of ground water.

D. Several Options for Developing Site-Specific Alternative Remediation Standards

In lieu of using the impact to ground water remediation standards, alternative remediation standards can be developed using site specific information and methodology provided by the Department. (See the Impact to Ground Water Basis and Background document) The options for developing site-specific alternative remediation standards are briefly described below:

- Option A. Modify input parameters in the simple partitioning equation using site specific data such as soil pH and soil organic carbon content. Calculate the site specific remediation standard.

- Option B. Determine whether the contaminant is on a list of immobile chemicals the Department has developed. Chemicals on the list might not require remediation to the impact to groundwater remediation standards provided that all of the caveats and conditions specified are met, such as an adequate clean zone above the water table.

- Option C. Perform the Synthetic Precipitation Leaching Procedure (SPLP) to determine the site specific leaching potential for inorganics, semi-volatile organics, and pesticides. Calculate the site specific remediation standard.

- Option D. Conduct transport modeling when soil contamination is present and ground water has not been impacted. Calculate the site specific remediation standard.

- Option E. Conduct vadose zone and ground water modeling when soil contamination is present and ground water has been impacted. Calculate the site specific remediation standard.

- Option F. Evaluate site specific ground water, soil analytical results, and water table conditions. If ground water impacts are not observed, remediation to the standards might not be required provided that all of the caveats and conditions specified are met.

E. Compliance

- Compliance sampling for the impact to ground water pathway continues to be conducted on a point-by-point basis.
- An alternate compliance sampling approach option is available for the monitored natural attenuation of petroleum hydrocarbon contaminated soil.

III. References

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